3D Printing Scaffold for Bone Regeneration

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Finding biocompatible, biodegradable, and osteoconductive substitutions for large bone defects have long challenged clinicians, especially those operating on soldiers with battlefield injuries. Current methods, such as autografts, can host donor site complications and are limited in quantity; allografts can be rejected by the immune system, resulting in a high failure rate. Vascular penetration is essential for delivering cells and growth factors that promote bone callus formation in large bone defect repair surgery. Although multiple signaling pathways are involved in the regulation of angiogenesis, evidence increasingly shows that JAG1-mediated Notch signaling plays a crucial role in angiogenesis. The objective of this project is to develop a 3D-printed PCL (polycaprolactone) scaffold coated with notch ligand Jagged1 (JAG1) for large bone defect repair. The 3D printed PCL scaffold showed better biomechanical properties than the allograft in our compression test. A direct absorbance assay showed that the JAG1 protein coated on the surface of PCL scaffold could hold onto and consistently release Jagged1 protein over several days. The cellular capability of the scaffold was also significantly enhanced by the JAG1 protein coating and seeded more endothelial progenitor cells than the allograft. This study suggests that this newly developed, 3D printed, Jagged1 coated, and stem cell seeded scaffold is a strong inducer of angiogenesis and bone formation.This method could potentially improve upon or replace current bone transplant methods, especially for servicemen.